CLAIMS

What is claimed is:

1. A communication network, comprising:

a plurality of first communication paths;

a plurality of second communication paths; and

a plurality of nodes, adjacent ones of said nodes being coupled together through at least one of said first communication paths and at least one of said second communication paths, each node comprising:

a plurality of switches, including a first switch and a second switch, each having a first terminal, a second terminal, a third terminal, and a fourth terminal, wherein the first terminal and the second terminal of said first switch are coupled through at least one of said first communication paths and at least one of said second communication paths, respectively, to a first, adjacent one of the nodes, the first terminal and the second terminal of said second switch are coupled through at least one other first communication path and at least one other second communication path, respectively, to a second, adjacent one of the nodes, and the third terminal of said first switch is coupled to the third terminal of said second switch through at least one third communication path;

at least one multiplexing/demultiplexing device bidirectionally coupled to each of an external communication node and the fourth terminal of each first and second switch, said at least one multiplexing/demultiplexing device for forwarding signals

being communicated between the fourth terminals of said first and second switches, and for forwarding signals being communicated between the external communication node and the fourth terminal of respective ones of said first and second switches; and

at least one controller coupled to said first and second switches, said at least one controller being responsive to applied input information for controlling at least one of said first and second switches to cause that at least one switch to selectively couple at least one of (a) the first and second adjacent nodes together by way of at least one of the first and second communication paths coupled to that at least one switch, and (b) the external communication node and at least one of the first and second, adjacent nodes by way of at least one of the first and second communication paths coupled to that at least one switch.

2. A communication network as set forth in Claim 1, wherein each of said first and second switches is a 4X4 optical switch.

3. A communication network as set forth in Claim 1, wherein said at least one multiplexing/demultiplexing device is a Wavelength- Division-Multiplexed (WDM) device.

4. A communication network as set forth in Claim 1, wherein said at least one multiplexing/demultiplexing device includes at least one add/drop multiplexer/demultiplexer.

5. A communication network as set forth in Claim 1, wherein said at least one multiplexing/demultiplexing device comprises:

a plurality of multiplexers, a first one of said multiplexers having a first input coupled to a first output of said external communication node, and an output coupled to the fourth terminal of said first switch, a second one of said multiplexers having a first input coupled to a second output of the external communication node, and an output coupled to the fourth terminal of said second switch; and

a plurality of demultiplexers, a first one of said demultiplexers having a first input coupled to the fourth terminal of said first switch, a first output coupled to a first input of the external communication node, and a second output coupled to a second input of said second multiplexer, a second one of said demultiplexers having a first input coupled to the fourth terminal of said second switch, a first output coupled to a second input of the external communication node, and a second output coupled to a second input of said first multiplexer,

wherein each of said first and second multiplexers couples individual signals received through the first and second inputs thereof to the output of that multiplexer, and each of said first and second demultiplexers couples signals applied to the input thereof to corresponding ones of the first and second outputs of that demultiplexer.

6. A communication network as set forth in Claim 5, wherein each node further comprises:

at least one first transponder interposed between both said first multiplexer and the external communication node and between said first demultiplexer and the external communication node, said at least one first transponder having a first input coupled to the first output of the external communication node, a second input coupled to the first output of said first demultiplexer, a first output coupled to the first input of said first multiplexer, and a second output coupled to the first input of the external communication node; and

at least one second transponder interposed between both said second multiplexer and the external communication node and between said second demultiplexer and the external communication node, said at least one second transponder having a first input coupled to the second output of the external communication node, a second input coupled to the first output of said second demultiplexer, a first output coupled to the first input of said second multiplexer, and a second output coupled to the second input of the external communication node.

7. A communication network as set forth in Claim 6, further comprising:

a first amplifier interposed between the output of said first multiplexer and the fourth terminal of said first switch;

a second amplifier interposed between the fourth terminal of said first switch and the input of said first demultiplexer;

a third amplifier interposed between the output of said second multiplexer and the fourth terminal of said second switch; and

a fourth amplifier interposed between the fourth terminal of said second switch and the input of said second demultiplexer.

8. A communication network as set forth in Claim 5, further comprising:

a first variable optical attenuator interposed between the fourth terminal of said first switch and the input of said first demultiplexer; and

a second variable optical attenuator interposed between the fourth terminal of said second switch and the input of said second demultiplexer.

9. A communication network as set forth in Claim 5, wherein said first multiplexer and said first demultiplexer are both included within a first optical line terminal, and wherein said second multiplexer and said second demultiplexer are both included within a second optical line terminal.

10. A communication network as set forth in Claim 1, wherein the first terminal of each of said first and second switches is normally coupled within the switch to the fourth terminal of that switch and the second terminal of each of said first and second switches is normally coupled within the switch to the third terminal of that switch, and wherein said at least one controller is

responsive to applied input information indicating that a failure has occurred in a first communication path for controlling at least one of said first and second switches to cause the first terminal of that at least one switch to be coupled to the third terminal of that switch, and to cause the second terminal of that at least one switch to be coupled to the fourth terminal of that switch, for coupling the at least one second communication path coupled to that second terminal to said at least one multiplexing/demultiplexing device.

11. A communication network as set forth in Claim 10, wherein said at least one controller is responsive to further applied input information for controlling the at least one of said first and second switches to cause the first terminal of that at least one switch to be coupled to the fourth terminal of that switch, and to cause the second terminal of that at least one switch to be coupled to the third terminal of that switch, for coupling the at least one first communication path coupled to that first terminal to said at least one multiplexing/demultiplexing device.

12. A communication network as set forth in Claim 1, wherein said at least one controller is responsive to applied input information indicating that a failure has occurred in at least one of said first and second communication paths for controlling one of said first and second switches of said node to cause the third terminal of that switch to be coupled to the fourth terminal of

that switch, for coupling said multiplexing/demultiplexing device through that switch, the third communication path, and the other switch of said node, to the second communication path coupled to that other switch.

13. A communication network as set forth in Claim 1, wherein each node further comprises at least one monitor for detecting the occurrence of a failure in at least one of said first and second communication paths, and wherein said at least one monitor responds to detecting a failure in that at least one communication path by applying the input information to said at least one controller.

14. A communication network as set forth in Claim 13, wherein said at least one monitor detects the occurrence of a failure in the at least one communication path by detecting the substantial absence of light in that path.

15. A communication network as set forth in Claim 13, wherein said at least one controller is coupled to at least one of the other nodes of the communication network through at least one of said first and second communication paths, and wherein said at least one controller is responsive to the input information being applied thereto by the at least one monitor for notifying the at least one other node of the detected failure by way of that at least one communication path.

16. A communication network as set forth in Claim 13, wherein said at least one controller is coupled to at

least one of the other nodes of the communication network through at least one of said first and second communication paths, and wherein the input information applied to the at least one controller is provided from the at least one other node by way of that at least one communication path.

17. A communication network as set forth in Claim 13, wherein said plurality of nodes are coupled together through said first and second communication paths, and form a loop configuration.

18. A communication network, comprising:

a plurality of first communication paths;

a plurality of second communication paths; and

a plurality of nodes, adjacent ones of said nodes being coupled together through at least two of said first communication paths and at least two of said second communication paths, each node comprising:

a plurality of first switches, each first switch having a first terminal, a second terminal, and a third terminal, the first terminal of each of a first group of said first switches being coupled to a first adjacent one of said nodes through a respective first communication path, the first terminal of each of a second group of said first switches being coupled to a second adjacent one of said nodes through a respective first communication path;

a plurality of second switches, each of a first group of said second switches having a first terminal coupled to the first adjacent node through a respective second

communication path, a second terminal coupled to the second terminal of a respective one of the first group of first switches, and a third terminal, each of a second group of said second switches having a first terminal coupled to the second adjacent node through a respective second communication path, a second terminal coupled to the second terminal of a respective one of the second group of first switches, and a third terminal coupled through a respective third communication path to the third terminal of a respective one of the first group of second switches;

at least one multiplexing/demultiplexing device coupled to each of an external communication node and the third terminal of each respective first switch, said at least one multiplexing/demultiplexing device for forwarding signals being communicated between the third terminals of corresponding first switches from the first and second groups of first switches, and for forwarding signals being communicated between the external communication node and the third terminal of respective ones of said first switches; and

at least one controller coupled to each of said first and second switches, said at least one controller being responsive to applied input information for controlling at least one of said first switches and at least one of said second switches to cause those switches to selectively couple at least one of (a) the corresponding adjacent nodes together by way of at least one of said first and second communication paths, and (b) the external communication node and at least one of the corresponding

adjacent nodes by way of at least one of said first and second communication paths.

19. A communication network as set forth in Claim 18, wherein each of said first and second switches is a 1X2 optical switch.

20. A communication network as set forth in Claim 18, wherein said at least one multiplexing/demultiplexing device is a Wavelength- Division-Multiplexed (WDM) device.

21. A communication network as set forth in Claim 18, wherein said at least one multiplexing/demultiplexing device includes at least one add/drop multiplexer/demultiplexer.

22. A communication network as set forth in Claim 18, wherein said at least one multiplexing/demultiplexing device comprises:

a plurality of multiplexers, a first one of said multiplexers having a first input coupled to a first output of said external communication node, and an output coupled to the third terminal of a first one of the first group of first switches, a second one of said multiplexers having a first input coupled to a second output of the external communication node, and an output coupled to the third terminal of a first one of the second group of first switches; and

a plurality of demultiplexers, a first one of said demultiplexers having an input coupled to the third

terminal of a second one of the first group of first switches, a first output coupled to a first input of the external communication node, and a second output coupled to a second input of said second multiplexer, a second one of said demultiplexers having an input coupled to the third terminal of a second one of the second group of first switches, a first output coupled to a second input of the external communication node, and a second output coupled to a second input of said first multiplexer,

wherein each of said first and second multiplexers couples individual signals received through the first and second inputs thereof to the output of that multiplexer, and each of said first and second demultiplexers couples signals applied to the input thereof to corresponding ones of the first and second outputs of that demultiplexer.

23. A communication network as set forth in Claim 22, wherein each node further comprises:

at least one first transponder interposed between both said first multiplexer and the external communication node and between said first demultiplexer and the external communication node, said at least one first transponder having a first input coupled to the first output of the external communication node, a second input coupled to the first output of said first demultiplexer, a first output coupled to the first input of said first multiplexer, and a second output coupled to the first input of the external communication node; and

at least one second transponder interposed between both said second multiplexer and the external

communication node and between said second demultiplexer and the external communication node, said at least one second transponder having a first input coupled to the second output of the external communication node, a second input coupled to the first output of said second demultiplexer, a first output coupled to the first input of said second multiplexer, and a second output coupled to the second input of the external communication node.

24. A communication network as set forth in Claim 23, further comprising:

a first amplifier interposed between the output of said first multiplexer and the third terminal of the first one of the first group of first switches;

a second amplifier interposed between the third terminal of the second one of the first group of first switches and the input of said first demultiplexer;

a third amplifier interposed between the output of said second multiplexer and the third terminal of the first one of the second group of first switches; and

a fourth amplifier interposed between the third terminal of the second one of the second group of first switches and the input of said second demultiplexer.

25. A communication network as set forth in Claim 23, further comprising:

a first variable optical attenuator interposed between the second terminal of one of said first switches and the second terminal of one of said second switches coupled to that first switch; and

a second variable optical attenuator interposed between the second terminal of another one of said first switches and the second terminal of another one of said second switches coupled to that first switch.

26. A communication network as set forth in Claim 23, wherein said first multiplexer and said first demultiplexer are both included within a first optical line terminal, and wherein said second multiplexer and said second demultiplexer are both included within a second optical line terminal.

27. A communication network as set forth in Claim 18, wherein the third terminal of each of said first and second switches is normally coupled within that switch to the first terminal of that switch, and wherein said at least one controller is responsive to applied input information indicating that a failure has occurred in at least one of said first communication paths for controlling at least one corresponding first switch and at least one corresponding second switch to cause the third terminal of each of those switches to be coupled to the second terminal of that switch, for coupling said multiplexing/demultiplexing device through each of those first and second switches, the third communication path, and another second switch coupled to that path, to the second communication path coupled to that other second switch.

28. A communication network as set forth in Claim 27, wherein said at least one controller is responsive to further applied input information for controlling the at least one corresponding first switch and the at least one corresponding second switch to cause the third terminal of each of those switches to be coupled within the switch to the first terminal of that switch, for coupling said multiplexing/demultiplexing device through that first switch to the first communication path coupled to that first switch, and for coupling together the corresponding adjacent nodes through that at least one corresponding second switch, the second communication path coupled to that second switch, and the third communication path.

29. A communication network as set forth in Claim 18, wherein each node further comprises at least one monitor for detecting the occurrence of a failure in at least one of said first and second communication paths, and wherein said at least one monitor responds to detecting a failure in that at least one communication path by applying the input information to said at least one controller.

30. A communication network as set forth in Claim 29, wherein said at least one monitor detects the occurrence of a failure in the at least one communication path by detecting the substantial absence of light in that path.

31. A communication network as set forth in Claim 29, wherein said at least one controller is coupled to at least one of the other nodes of the communication network

through at least one of said first and second communication paths, and wherein said controller is responsive to the input information applied thereto by the at least one monitor for notifying the at least one other node of the detected failure by way of that communication path.

32. A communication network as set forth in Claim 29, wherein said at least one controller is coupled to at least one of the other nodes of the communication network through at least one of said first and second communication paths, and wherein the input information applied to the at least one controller is provided from the at least one other node by way of that at least one communication path.

33. A communication network as set forth in Claim 29, wherein said plurality of nodes are coupled together through said first and second communication paths, and form a loop configuration.

34. A communication network, comprising:

a plurality of first communication paths;

a plurality of second communication paths; and

a plurality of nodes, adjacent ones of said nodes being coupled together through at least two of said first communication paths and at least two of said second communication paths, each node comprising:

a plurality of first switches, each having a first terminal, a second terminal, a third terminal, and a

fourth terminal, the first terminal of each of a first group of said first switches being coupled to a first adjacent one of said nodes through a respective first communication path, the first terminal of each of a second group of said first switches being coupled through a respective first communication path to a second adjacent one of said nodes;

a plurality of second switches, each of a first group of said second switches having a first terminal coupled to the first adjacent node through a respective second communication path, a second terminal coupled to the second terminal of a respective one of the first group of first switches, a third terminal, and a fourth terminal which is coupled to the fourth terminal of another respective one of the first group of first switches, each of a second group of said second switches having a first terminal coupled to the second adjacent node through a respective second communication path, a second terminal coupled to the second terminal of a respective one of the second group of first switches, a third terminal coupled to the third terminal of a respective one of the first group of second switches, and a fourth terminal coupled to the fourth terminal of another respective one of the second group of first switches;

at least one multiplexing/demultiplexing device coupled to each of an external communication node and the third terminal of each respective first switch, said at least one multiplexing/demultiplexing device for forwarding signals being communicated between the third terminals of corresponding first switches from the first

and second groups of first switches, and for forwarding signals being communicated between the external communication node and the third terminal of respective ones of said first switches; and

at least one controller coupled to each of said first and second switches, said at least one controller being responsive to applied input information for controlling at least one of the first switches and at least one of the second switches to cause those switches to selectively couple together at least one of (a) the first and second adjacent nodes together by way of at least one of said first and second communication paths, and (b) the external communication node and at least one of the first and second adjacent nodes by way of at least one of said first and second communication paths.

35. A communication network as set forth in Claim 34, wherein each of said first switches is a 1X3 optical switch and each of said second switches is a 2X2 optical switch.

36. A communication network as set forth in Claim 34, wherein said at least one multiplexing/demultiplexing device is a Wavelength- Division-Multiplexed (WDM) device.

37. A communication network as set forth in Claim 34, wherein said at least one multiplexing/demultiplexing device includes at least one add/drop multiplexer/demultiplexer.

38. A communication network as set forth in Claim 34, wherein said at least one multiplexing/demultiplexing device comprises:

a plurality of multiplexers, a first one of said multiplexers having a first input coupled to a first output of said external communication node, and an output coupled to the third terminal of a first one of the first group of first switches, a second one of said multiplexers having a first input coupled to a second output of the external communication node, and an output coupled to the third terminal of a first one of the second group of first switches; and

a plurality of demultiplexers, a first one of said demultiplexers having an input coupled to the third terminal of a second one of the first group of first switches, a first output coupled to a first input of the external communication node, and a second output coupled to a second input of said second multiplexer, a second one of said demultiplexers having an input coupled to the third terminal of a second one of the second group of first switches, a first output coupled to a second input of the external communication node, and a second output coupled to a second input of said first multiplexer,

wherein each of said first and second multiplexers couples individual signals received through the first and second inputs thereof to the output of that multiplexer, and each of said first and second demultiplexers couples signals applied to the input thereof to corresponding ones of the first and second outputs of that demultiplexer.

39. A communication network as set forth in Claim 38, further comprising:

at least one first transponder interposed between both said first multiplexer and the external communication node and between said first demultiplexer and the external communication node, said at least one first transponder having a first input coupled to the first output of the external communication node, a second input coupled to the first output of said first demultiplexer, a first output coupled to the first input of said first multiplexer, and a second output coupled to the first input of the external communication node; and

at least one second transponder interposed between both said second multiplexer and the external communication node and between said second demultiplexer and the external communication node, said at least one second transponder having a first input coupled to the second output of the external communication node, a second input coupled to the first output of said second demultiplexer, a first output coupled to the first input of said second multiplexer, and a second output coupled to the second input of the external communication node.

40. A communication network as set forth in Claim 38, further comprising:

a first amplifier interposed between the output of said first multiplexer and the third terminal of the first one of the first group of first switches;

a second amplifier interposed between the third terminal of the second one of the first group of first switches and the input of said first demultiplexer;

a third amplifier interposed between the output of said second multiplexer and the third terminal of the first one of the second group of first switches; and

a fourth amplifier interposed between the third terminal of the second one of the second group of first switches and the input of said second demultiplexer.

41. A communication network as set forth in Claim 38, further comprising:

a first variable optical attenuator interposed between the second terminal of one of said first switches and the second terminal of one of said second switches coupled to that first switch; and

a second variable optical attenuator interposed between the second terminal of another one of said first switches and the second terminal of another one of said second switches coupled to that first switch.

42. A communication network as set forth in Claim 38, wherein said first multiplexer and said first demultiplexer are both included within a first optical line terminal, and wherein said second multiplexer and said second demultiplexer are both included within a second optical line terminal.

43. A communication network as set forth in Claim 34, wherein the third terminal of each of said first and

second switches is normally coupled in the switch to said first terminal of that switch, and wherein said at least one controller is responsive to applied input information indicating that a failure has occurred in at least one of said first communication paths for controlling at least one corresponding first switch and at least one corresponding second switch to cause the third terminal of that first switch to be coupled to the fourth terminal of that first switch, and to cause the fourth terminal of that second switch to be coupled to the first terminal of that second switch, for coupling said multiplexing/demultiplexing device through those first and second switches to the second communication path coupled to that second switch.

44. A communication network as set forth in Claim 43, wherein said at least one controller is responsive to further applied input information for controlling said at least one corresponding first switch and said at least one corresponding second switch to cause the third terminal of that first switch to be coupled to the first terminal of that first switch, and to cause the third terminal of that second switch to be coupled to the first terminal of that second switch, for coupling said multiplexing/demultiplexing device to the first communication path coupled to that first switch.

45. A communication network as set forth in Claim 34, wherein said at least one controller is responsive to applied input information indicating that a failure has

occurred in at least one of said first and second communication paths for controlling at least one corresponding first switch and at least one corresponding second switch to cause the third terminal of that first switch to be coupled to the second terminal of that first switch, and to cause the second terminal of that second switch to be coupled to the third terminal of that second switch, for coupling said multiplexing/demultiplexing device through those first and second switches, the third communication path, and another second switch coupled to that path, to the second communication path coupled to that other second switch.

46. A communication network as set forth in Claim 34, wherein each node further comprises at least one monitor for detecting the occurrence of a failure in at least one of said first and second communication paths, and wherein said at least one monitor responds to detecting a failure in that at least one communication path by applying the input information to said at least one controller.

47. A communication network as set forth in Claim 46, wherein said at least one monitor detects the occurrence of a failure in the at least one communication path by detecting the substantial absence of light in that path.

48. A communication network as set forth in Claim 46, wherein said at least one controller is coupled to at least another one of said nodes of the communication network through at least one of said first and second

communication paths, and wherein said controller is responsive to the input information applied thereto by the at least one monitor for notifying the at least one other node of the detected failure by way of that communication path.

49. A communication network as set forth in Claim 34, wherein said at least one controller is coupled to at least another one of said nodes of the communication network through at least one of said first and second communication paths, and wherein the input information applied to the at least one controller is provided from the at least one other node by way of that at least one communication path.

50. A communication network as set forth in Claim 34, wherein said plurality of nodes are coupled together through said first and second communication paths, and form a loop configuration.

51. A node operating in a communication network having a plurality of nodes that are coupled together through first and second communication paths, said node comprising:

a first switch having a first terminal coupled to a first adjacent one of the nodes through a respective first communication path, and a second terminal coupled to the first adjacent node through a respective second communication path, said first switch also having a third terminal and a fourth terminal;

a second switch having a first terminal coupled to a second adjacent one of the nodes through a respective first communication path, a second terminal coupled to that second adjacent node through a respective second communication path, a third terminal, and a fourth terminal, wherein the third terminal of said second switch is coupled to the third terminal of said first switch through at least one third communication path;

at least one multiplexing/demultiplexing device bidirectionally coupled to each of an external communication node and the fourth terminal of each first and second switch, said at least one multiplexing/demultiplexing device for forwarding signals being communicated between the fourth terminals of said first and second switches, and for forwarding signals being communicated between the external communication node and the fourth terminal of respective ones of said first and second switches; and

at least one controller coupled to said first and second switches, said at least one controller being responsive to applied input information for controlling at least one of said first and second switches to cause that at least one switch to selectively couple at least one of (a) the first and second adjacent nodes together by way of at least one of the first and second communication paths, and (b) the external communication node and at least one of the first and second adjacent nodes by way of at least one of the first and second communication paths coupled to that at least one switch.

52. A node as set forth in Claim 51, wherein said at least one multiplexing/demultiplexing device is a Wavelength-Division-Multiplexed (WDM) device.

53. A node set forth in Claim 51, wherein said at least one multiplexing/demultiplexing device comprises:

a plurality of multiplexers, a first one of said multiplexers having a first input coupled to a first output of said external communication node, and an output coupled to the fourth terminal of said first switch, a second one of said multiplexers having a first input coupled to a second output of the external communication node, and an output coupled to the fourth terminal of said second switch; and

a plurality of demultiplexers, a first one of said demultiplexers having an input coupled to the fourth terminal of said first switch, a first output coupled to a first input of the external communication node, and a second output coupled to a second input of said second multiplexer, a second one of said demultiplexers having a first input coupled to the fourth terminal of said second switch, a first output coupled to a second input of the external communication node, and a second output coupled to a second input of said first multiplexer,

wherein each of said first and second multiplexers couples individual signals received through the first and second inputs thereof to the output of that multiplexer, and each of said first and second demultiplexers couples signals applied to the input thereof to corresponding ones of the first and second outputs of that demultiplexer.

54. A node as set forth in Claim 51, wherein the first terminal of each of said first and second switches is normally coupled in the switch to the fourth terminal of that switch and the second terminal of each of said first and second switches is normally coupled in that switch to the third terminal of that switch, and wherein said at least one controller is responsive to applied input information indicating that a failure has occurred in at least one first communication path for controlling at least one of said first and second switches to cause the first terminal of that at least one switch to be coupled to the third terminal of that switch, and to cause the second terminal of that at least one switch to be coupled to the fourth terminal of that switch, for coupling the at least one second communication path coupled to that second terminal to said at least one multiplexing/demultiplexing device.

55. A node as set forth in Claim 51, wherein said at least one controller is responsive to applied input information indicating that a failure has occurred in at least one of said first and second communication paths for controlling one of said first and second switches of said node to cause the third terminal of that switch to be coupled to the fourth terminal of that switch, for coupling said multiplexing/demultiplexing device through that switch, the third communication path, and the other switch of said node, to the second communication path coupled to that other switch.

56. A node as set forth in Claim 51, further comprising at least one monitor for detecting the occurrence of a failure in at least one of said first and second communication paths, and wherein said at least one monitor is responsive to detecting a failure in that at least one communication path by applying the input information to said at least one controller.

57. A node as set forth in Claim 56, wherein said at least one controller is responsive to the input information applied thereto by the at least one monitor for notifying at least one of said adjacent nodes of the detected failure by way of that communication path.

58. A node as set forth in Claim 51, wherein said at least one controller is coupled to at least one of the first and second adjacent nodes through at least one of said first and second communication paths, and wherein the input information applied to the at least one controller is provided from at least one of those nodes by way of that at least one communication path.

59. A node operating in a communication network having a plurality of nodes that are coupled together through first and second communication paths, said node comprising:

a plurality of first switches, each first switch having a first terminal, a second terminal, and a third terminal, the first terminal of each of a first group of said first switches being coupled to a first adjacent one of said nodes through a respective first communication

path, the first terminal of each of a second group of said first switches being coupled to a second adjacent one of said nodes through a respective first communication path;

a plurality of second switches, each of a first group of said second switches having a first terminal coupled to the first adjacent node through a respective second communication path, a second terminal coupled to the second terminal of a respective one of the first group of first switches, and a third terminal, each of a second group of said second switches having a first terminal coupled to the second adjacent node through a respective second communication path, a second terminal coupled to the second terminal of a respective one of the second group of first switches, and a third terminal coupled through a respective third communication path to the third terminal of a respective one of the first group of second switches;

at least one multiplexing/demultiplexing device coupled to each of an external communication node and the third terminal of each respective first switch, said at least one multiplexing/demultiplexing device for forwarding signals being communicated between the third terminals of corresponding first switches from the first and second groups of first switches, and for forwarding signals being communicated between the external communication node and the third terminal of respective ones of said first switches; and

at least one controller coupled to each of said first and second switches, said at least one controller being responsive to applied input information for controlling at

least one of the first switches and at least one of the second switches to cause those switches to selectively couple at least one of (a) the corresponding adjacent nodes together by way of at least one of said first and second communication paths, and (b) the external communication node and at least one of the corresponding adjacent nodes by way of at least one of said first and second communication paths.

60. A node as set forth in Claim 59, wherein said at least one multiplexing/demultiplexing device comprises:

a plurality of multiplexers, a first one of said multiplexers having a first input coupled to a first output of said external communication node, and an output coupled to the third terminal of a first one of the first group of first switches, a second one of said multiplexers having a first input coupled to a second output of the external communication node, and an output coupled to the third terminal of a first one of the second group of first switches; and

a plurality of demultiplexers, a first one of said demultiplexers having an input coupled to the third terminal of a second one of the first group of first switches, a first output coupled to a first input of the external communication node, and a second output coupled to a second input of said second multiplexer, a second one of said demultiplexers having an input coupled to the third terminal of a second one of the second group of first switches, a first output coupled to a second input

of the external communication node, and a second output coupled to a second input of said first multiplexer,

wherein each of said first and second multiplexers couples individual signals received through the first and second inputs thereof to the output of that multiplexer, and each of said first and second demultiplexers couples signals applied to the input thereof to corresponding ones of the first and second outputs of that demultiplexer.

61. A node as set forth in Claim 59, wherein the third terminal of each of said first and second switches is normally coupled within that switch to the first terminal of that switch, and wherein said at least one controller is responsive to applied input information indicating that a failure has occurred in at least one of said first communication paths for controlling at least one corresponding first switch and at least one corresponding second switch to cause the third terminal of each of those switches to be coupled to the second terminal of that switch, for coupling said multiplexing/demultiplexing device through each of those first and second switches, the third communication path, and another second switch coupled to that path, to the second communication path coupled to that other second switch.

62. A node as set forth in Claim 59, wherein said node further comprises at least one monitor for detecting the occurrence of a failure in at least one of said first and second communication paths, and wherein said at least one monitor is responsive to detecting a failure in that at

least one communication path by applying the input information to said at least one controller.

63. A node as set forth in Claim 59, wherein said controller is responsive to the input information applied thereto by the at least one monitor for notifying at least one of the adjacent nodes of the detected failure by way of at least one of the communication paths.

64. A node as set forth in Claim 59, wherein said at least one controller is coupled to at least one of the first and second adjacent nodes of the communication network through at least one of said first and second communication paths, and wherein the input information applied to the at least one controller is provided from at least one of those first and second adjacent nodes by way of that at least one communication path.

65. A node operating in a communication network having a plurality of nodes that are coupled together through first and second communication paths, said node comprising:

a plurality of first switches, each having a first terminal, a second terminal, a third terminal, and a fourth terminal, the first terminal of each of a first group of said first switches being coupled to a first adjacent one of said nodes through a respective first communication path, the first terminal of each of a second group of said first switches being coupled through a respective first communication path to a second adjacent one of said nodes;

a plurality of second switches, each of a first group of said second switches having a first terminal coupled to the first adjacent node through a respective second communication path, a second terminal coupled to the second terminal of a respective one of the first group of first switches, a third terminal, and a fourth terminal which is coupled to the fourth terminal of another respective one of the first group of first switches, each of a second group of said second switches having a first terminal coupled to the second adjacent node through a respective second communication path, a second terminal coupled to the second terminal of a respective one of the second group of first switches, a third terminal coupled to the third terminal of a respective one of the first group of second switches, and a fourth terminal coupled to the fourth terminal of another respective one of the second group of first switches;

at least one multiplexing/demultiplexing device coupled to each of an external communication node and the third terminal of each respective first switch, said at least one multiplexing/demultiplexing device for forwarding signals being communicated between the third terminals of corresponding first switches from the first and second groups of first switches, and for forwarding signals being communicated between the external communication node and the third terminal of respective ones of said first switches; and

at least one controller coupled to each of said first and second switches, said at least one controller being responsive to applied input information for controlling at

least one of the first switches and at least one of the second switches to cause those switches to selectively couple at least one of (a) the first and second adjacent nodes together by way of at least one of said first and second communication paths, and (b) the external communication node and at least one of the first and second adjacent nodes by way of at least one of said first and second communication paths.

66. A node as set forth in Claim 65, wherein said at least one multiplexing/demultiplexing device comprises:

a plurality of multiplexers, a first one of said multiplexers having a first input coupled to a first output of said external communication node, and an output coupled to the third terminal of a first one of the first group of first switches, a second one of said multiplexers having a first input coupled to a second output of the external communication node, and an output coupled to the third terminal of a first one of the second group of first switches; and

a plurality of demultiplexers, a first one of said demultiplexers having an input coupled to the third terminal of a second one of the first group of first switches, a first output coupled to a first input of the external communication node, and a second output coupled to a second input of said second multiplexer, a second one of said demultiplexers having an input coupled to the third terminal of a second one of the second group of first switches, a first output coupled to a second input

of the external communication node, and a second output coupled to a second input of said first multiplexer,

wherein each of said first and second multiplexers couples individual signals received through the first and second inputs thereof to the output of that multiplexer, and each of said first and second demultiplexers couples signals applied to the input thereof to corresponding ones of the first and second outputs of that demultiplexer.

67. A node as set forth in Claim 65, wherein the third terminal of each of said first and second switches is normally coupled in the switch to said first terminal of that switch, and wherein said at least one controller is responsive to applied input information indicating that a failure has occurred in at least one of said first communication paths for controlling at least one corresponding first switch and at least one corresponding second switch to cause the third terminal of that first switch to be coupled to the fourth terminal of that first switch, and to cause the fourth terminal of that second switch to be coupled to the first terminal of that second switch, for coupling said multiplexing/demultiplexing device through those first and second switches to the second communication path coupled to that second switch.

68. A node as set forth in Claim 65, wherein said at least one controller is responsive to applied input information indicating that a failure has occurred in at least one of said first and second communication paths for controlling at least one corresponding first switch and at

least one corresponding second switch to cause the third terminal of that first switch to be coupled to the second terminal of that first switch, and to cause the second terminal of that second switch to be coupled to the third terminal of that second switch, for coupling said multiplexing/demultiplexing device through those first and second switches, the third communication path, and another second switch coupled to that path, to the second communication path coupled to that other second switch.

69. A node as set forth in Claim 65, further comprising at least one monitor for detecting the occurrence of a failure in at least one of said first and second communication paths, and wherein said at least one monitor is responsive to detecting a failure in that at least one communication path by applying the input information to said at least one controller.

70. A node as set forth in Claim 65, wherein said controller is responsive to the input information applied thereto by the at least one monitor for notifying at least one of the adjacent nodes of the detected failure by way of at least one of the communication paths.

71. A node as set forth in Claim 65, wherein said at least one controller is coupled to at least one of the adjacent nodes through at least one of said first and second communication paths, and wherein the input information applied to the at least one controller is

provided from at least one of those adjacent nodes by way of at least one of the communication paths.

72. A communication network, comprising:

at least one communication path;

a plurality of nodes coupled in said at least one communication path, each node comprising:

at least one controller,

at least one multiplexing/demultiplexing device coupled to a corresponding external terminal, and

a plurality of switches, said switches being controllable by said at least one controller for selectively coupling signals between said multiplexer/demultiplexer device and said at least one communication path, and for selectively coupling signals through said node to and from said at least one communication path, without forwarding those signals through said multiplexer/demultiplexer device.

73. A communication network as set forth in Claim 72, wherein the at least one communication path includes a plurality of communication paths, said at least one controller of at least one of said nodes is responsive to applied input information indicating that a failure has occurred in at least one of those communication paths for controlling at least one of said switches of that node to enable signals to be exchanged between at least one other, selected one of the communication paths and the multiplexing/demultiplexing device of that node by way of that at least one switch.

74. A communication network as set forth in Claim 73, wherein in a case in which the switches in first and second ones of the nodes are controlled for enabling signals to be exchanged with the at least one other, selected communication path, those signals also are exchanged between those first and second nodes by way of that at least one other, selected communication path.

75. A communication network as set forth in Claim 73, wherein a third one of the nodes is interposed in the at least one communication path between one side of the first node and one side of the second node, and wherein said controller of the first node controls at least one of said switches of the first node and said controller of the second node controls at least one of said switches of the second node to provide a loopback switching arrangement for enabling signals to be exchanged between the first and second nodes through the third node.

76. A line node, comprising:

at least one controller;

at least one multiplexing/demultiplexing device coupled to an external terminal; and

a plurality of switches, controllable by said at least one controller, for selectively coupling signals between said at least one multiplexing/demultiplexing device and the at least one external communication path, and for selectively coupling signals through said line node to and from the at least one external communication

path, without forwarding those signals through said at least one multiplexing/demultiplexing device.

77. A method for operating a communication network that includes a plurality of nodes coupled together through at least one communication path, the nodes exchanging signals with one another through the at least one communication path, the method comprising the steps of:

detecting a failure in the at least one communication path; and

in response to the detecting step, controlling at least one of a plurality of switches in at least one of the nodes to enable the signals to be exchanged between at least two of the nodes through at least one alternate communication path.

78. A method as set forth in Claim 77, further comprising the step of multiplexing at least some of the signals within at least one of the nodes.

79. A method as set forth in Claim 77, further comprising the step of demultiplexing at least some of the signals within at least one of the nodes.

80. A method as set forth in Claim 77, wherein the controlling step is performed to loopback signals from a first node to a second node through a third node interposed between the first and second nodes.

81. A method as set forth in Claim 77, wherein the nodes and the at least one communication path collectively form a loop configuration.

82. A method for operating a line node of a communication network, the line node being coupled to an external communication terminal and also being coupled in a plurality of communication paths in which a plurality of other line nodes are also coupled, the method comprising the steps of:

providing a plurality of switches in the line node, coupled to the external communication terminal;

detecting a failure in at least one of the communication paths; and

in response to the detecting step, controlling the plurality of switches in the line node to cause those switches to selectively couple signals between the external communication terminal and at least one alternate one of the communication paths coupled to the line node, for enabling those signals to be selectively communicated between the external terminal and at least one other line node of the communication network.

83. A method as set forth in Claim 82, wherein the line node further comprises a multiplexing/demultiplexing device interposed between the external communication device and the plurality of switches.

84. A computer readable program for executing a method for operating a line node of a communication network, the

line node being coupled to an external terminal and also being coupled in a plurality of communication paths in which a plurality of other line nodes are also coupled, the line node comprising a plurality of switches, the method comprising the steps of:

detecting a failure in at least one of the communication paths; and

in response to the detecting step, controlling the plurality of switches in the line node to cause those switches to selectively couple signals between the external terminal and at least one alternate one of the communication paths coupled to the line node, for enabling those signals to be selectively communicated between the external terminal and at least one other line node of the communication network.

85. A method as set forth in Claim 77, wherein the detecting step includes:

at a first one of the nodes, detecting a failure in a first one of the communication paths, and communicating a first failure notification to a second, adjacent one of the nodes through at least a third one of the communication paths coupled to those first and second nodes; and

at the second, adjacent node, detecting a failure in a second one of the communication paths, and communicating a second failure notification to the first node through the at least third one of the communication path, and wherein the controlling step includes:

in response to the first node receiving the second failure notification, controlling at least one of a plurality of switches in the first node to enable the signals to be exchanged between the first node and the at least one alternate communication path; and

in response to the second node receiving the first failure notification, controlling at least one of a plurality of switches in the second node to enable the signals to be exchanged between the first and second nodes through the at least one alternate communication path.

86. A node as set forth in Claim 55, wherein said at least one controller is responsive to applied input information indicating that the at least one of said first and second communication paths in which the failure occurred has been restored for controlling said one of said first and second switches of said node to cause the first terminal of that switch to be coupled to the fourth terminal of that switch, for coupling said multiplexing/demultiplexing device through that switch to the first communication path coupled to that switch, and to cause the second terminal of that switch to be coupled to the third terminal of that switch.